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The
Mechanics of Piano Technic

A Primer
of

The Movements and Forces Used in Piano Playing,
with Precise Analysis in the
Method of Modern Physical Science

By
Ethelbert Warren Grabill
University of South Dakota

1909
The Lakeside Press
R. R. DONNELLEY & SONS COMPANY
CHICAGO

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Mus 342.25
HARVARD UNIVERSITY
DEPARTMENT OF MUSIC
E 26'43
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The Lakeside Press
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CHICAGO

TO HEINRICH BARTH

MASTER PIANIST

WHOSE CATHOLIC TUITION STIMULATED THE
INDEPENDENCE OF THOUGHT NECESSARY
TO PRODUCE THIS LITTLE VOLUME,
IT IS GRATEFULLY INSCRIBED

PREFACE

IN presenting the present brief treatise, it is proper to define its relation to existing works on piano technic. No pretense is made that it is a compendium of that subject from all standpoints. Such works have been undertaken from time to time, and occasionally have been highly successful transcripts of pianistic ideas up to the date of their publication.

Adolph Kullak's "Æsthetics of Piano Playing," though written more than thirty years ago, treats of technic, historically, scientifically, and artistically, in a manner far more thorough than any work previous to the present decade. The recent admirable work of Tobias Mathay, "The Act of Touch," while more limited in scope, covers with even greater system and attention to detail a wide field in pianism. I heartily recommend these two works to all thoughtful students of piano technic.

As will be seen, I do not agree with all the conclusions in these works in the field which I cover. But I limit the scope of my inquiry to a single aspect of technic—the mechanical. Their wider scope prepares the student for any more intensive examination, such as I propose.

The works of William Mason, which have been edited and explained by so able a coadjutor as W. S. B. Mathews, are also extremely valuable to the pianist, though presented more largely in experimental than in theoretic form. It is unfortunate that some of his most original reflections are contained in his earlier writings, now out of print.

More desultory are the works of Amy Fay, Bettina Walker, Elisabeth Calland, Ehrenfechter, and others, which contain incomplete description of the mechanical and æsthetic ideas of such masters as Deppe, Henselt,

and Scharwenka. But they too are useful to students, as are the works, perhaps more dependent upon dogma than systematic theory, of the modern disciples of the Leschetitzky school.

The present primer has a more concentrated object than any of the works mentioned. It has in view the direction of pianists' attention to the facts that piano technic is in one aspect susceptible of analysis in the terms of physics and mechanics; that such a treatment is precise in process and clear in results, and is therefore highly practical for intelligent students and teachers of the piano.

I have attempted to pursue these objects in a suggestive and elementary rather than in an exhaustive manner. Hence the word "primer" as applied to the volume. While the main object in writing it was as above described, one result of the method of inquiry used has been, it is believed, an ampler and perhaps a new description of technic in several respects.

These are: (1) The division of technic for systematic analysis into *dynamic* (force-producing, therefore tone-producing), and *adjustive*. (2) The description in a thorough manner, so as to make their management practicable for students of the *actions* and *reactions* (especially the latter) of the main piano-playing levers, and their highly important relations. (3) The fact that *all movements in piano playing are in arcs*, not straight lines, and that the understanding of this has a very simplifying effect on some of the most difficult technical problems.

The mechanical elements of technic are simple. It is the practical combination of these elements which is difficult to effect by a theoretic system. And they may be combined in many proportions. This tempts the practical pianist to declare that the use of principles only leads to complexity; that method only results in obscurity and pedantry. That is indeed a danger. But the true principles applied in the right way must clarify. Applied

without discernment they might be useless, no matter how true.

The effort in the following pages to make plain the mechanical principles which underlie all the acts of piano playing is followed by analysis in detail of a few of the most important combinations of these elements. The intelligent student will thereby learn how to reason out the management of other combinations in leverage or movement. By practicing these in the special passages to which they are adapted, they become automatic in such passages. They do this the more quickly because they are based on the natural construction of the technical apparatus, and the natural laws of its operation. Science and instinct are thus allied, and what is learned more quickly remains more permanently.

It is believed, therefore, that an effective technical command of the piano may be acquired more quickly and surely by means of the scientific procedure herein outlined than by commonly accepted methods, even those having the warrant of high pedagogic authority. More than this, pianists who already possess large technic may increase the power and facility of its application by systematizing and scientifically correcting their dynamic and adjustive actions, and becoming sensitive to the feeling of correct leverages, whereby a minimum of friction and a maximum of effectiveness is attained.

They whom Nature has endowed with instinctive skill often feel little need of intellectually grasping the laws with which she has underlaid this skill. Or even if they misapprehend them, the skill may nevertheless remain. To those whom Nature has denied physical knack or talent, the laws by which it may be attained are most valuable compensation. But they who, having natural capacity, acquire knowledge of its laws become possessed of a trebly rich endowment.

E. W. G.

January 1, 1909.

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INTRODUCTION

BETWEEN the musical concept in the brain of the pianist and the tonal resultant of the composition which he plays lie two sets of mechanical processes. One set of these processes is performed by the machinery of the pianoforte, and is, in the main, subject-matter for the inventors and makers of that instrument. The other set of processes is accomplished by the physical machinery of the player. The various pianofortes of the present day are very much alike, differing more on account of perfection or imperfection of detail than in their general plan. Similarly, the player's physical machinery may differ from others in the adaptability of its details, but is like all human bodies in general design and working system.

There are two mechanisms between the player's brain and the pianistic tonal result.

A method of piano-playing will, therefore, be preceded by a conception of those parts of the human body, and their working, which are of use in operating the machinery of the pianoforte. These parts and processes being the same for every normal individual, a general theory of piano technic will be the same for every player. But since the details of the human machinery differ in different persons, the *proportions* of work to be accomplished by any part or combination of parts will be different for each individual. In other words, the *general laws* of technic are the same for all, but their application varies as the components of each technical mechanism vary in detail. It will also vary with the mechanism of the particular pianoforte to which it is applied.

The general laws of technic are alike for all.

One of the main obstacles to general agreement upon the principles of technic is the survival of ideas suited to the ancestors of the present piano, but quite unsuited to

Survivals of technic suited to older instruments form a great obstacle to agreement on technical principles.

our vastly altered instrument, and the equally altered music composed for it. As the construction of the piano improved, and the music written for it changed in character, the technical methods of those who found it necessary to use new means of playing the new instruments and music were always criticised. The critics were the teachers and conservators of methods used in playing the older pianos and compositions.

Celebrated cases witness this fact.

Witness the case of Beethoven's music upon the new pianos of that day. Witness also the later examples of Chopin and Schumann, whose music was decried in high quarters as being unfit for the piano, whereas it was merely unsuited to the technical methods of those who essayed to play it. Even Liszt himself, wonderful master of technical processes that he was, and innovator of necessity from the very nature of the heavy instruments then coming in and the orchestral nature of his compositions,—even such a virtuoso doubted the authority of his own innovations, and referred pupils to older and inferior technical methods.[1]

The tendency is still operative.

Surprising as it may seem, this tendency is operative even at the present time, in this era so prolific of pianistic artists, and after the fruitage of so many technical theories. Not among the artists, however, is the tendency strong. It is powerful, as always, in the schools, among the teachers and theorists. And this is so for the same reason as of old—because technical advances are usually empirical. That is to say, they are derived from experience, as in the cases of Beethoven and Liszt. They are forced by the necessities of the case upon masters who possess pianistic instinct and invention, and who do not wait for theory, nor permit themselves to be held back by the teachers. A later generation methodizes the advances in technic, and progress goes on.

This preceding of the systematic by the instinctive, of

[1] Mason, "Memories of a Musical Life."

the theoretical by the empirical, must always exist in some degree. New powers will be discovered by performers when suggested by their own reproductive genius, or made necessary by new pianos or composers. The teacher follows with his analysis, and finally accounts for and explains processes already approved by experience.

The experiential always precedes the theoretical.

The great pianistic artists of the present day approach very near to each other in the main technical processes of which they make use. They do this partly through theory, but largely through necessity and instinct. While most of these processes have been described by writers on technic, there are vital elements of technic which are made use of in some degree by most great artists, which have not yet been systematically described or taught. And apparently, if such of these elementary processes as are thus empirically used should be separated for scientific analysis, explained and systematized for methodic use, there would be a great gain for the piano student and teacher.

Present day artists have substantially similar technic, which is not yet all satisfactorily explained.

It is the aim of the present work to do this in as accurate a manner as may consist with brevity. In order to do it with satisfactory thoroughness, some basic analysis of the whole field of technic is necessary, because no previous analysis has been made in a manner suiting the purposes of the writer. It is believed that therein may be found distinctions worth making which have not previously been made, which lead to the appreciation of facts whose truth and worth have hitherto passed unnoticed. In the main, the appeal is to a treatment of these facts and distinctions in the terms of physics and mechanics, as tending to a greater precision than the treatment usually accorded the subject. But minute completeness of scientific description is not pretended. That would make the work too mathematical and otherwise complicated for practical use by students and teachers. To suggest in a precise way really essential lines of improve-

To analyze elementary technical processes according to mechanical and physical laws is the present aim.

ment in technical theory, and to sketch processes which can be verified by deeper analysis—these purposes, carried out in a manner really helpful to the serious student, are more in line with the present intent.

The reader is urged to follow out at the keyboard, step by step, all the processes discussed, when they refer to actions at the keyboard. They will thus become much clearer. A preliminary examination of the marginal notes, and the concluding chapter, would also afford a valuable bird's-eye view of the outlines of the argument.

CHAPTER I

Preliminary Analysis of Technical Activities

VIOLIN technic may be rationally divided into two parts: that of the left hand, which determines the *distribution* of the tones as to pitch, and that of the right hand, which transmits through the bow the *force* producing those tones. Though not so obviously, piano technic is quite as rationally divided into the same two elements — tonal *distribution* and *production*. We may call those actions which attend to distribution *adjustive*, and those which apply force in the actual production of tone, *dynamic*.

Technical actions of two kinds: adjustive and dynamic.

Dynamic activities may be said to be the uses of certain levers or combinations of levers, with their concomitant muscles, to depress the keys of the piano, thereby producing tone. Technic which produces tone may be called dynamic, as may also the motions and the mechanism taking part in tone production.

Dynamic actions defined.

Adjustive activities are of two subdivisions: (1) those which distribute the tone-producing mechanism over the piano keys at the proper time, such as movements of the arm along the keyboard, passing the thumb under the fingers, spreading the fingers apart for chords, and the like; and (2) those which prepare the dynamic levers for producing tone, such as movements of the fingers, hand, or arm upward and away from the keys. The purpose of these two kinds of adjustment is quite distinguishable, but their action is often blended or simultaneous. They may be designated as *lateral* (sidewise), and *preparatory-dynamic*. The preparatory-dynamic motions are usually vertical, or approximately so, though they may also be away from the keys about to be depressed, in a backward

Adjustive actions defined.

or other direction, or even in a combination of directions. They always relax the muscles controlling at least one of the dynamic levers about to be used.

It is not only possible, but of the greatest use, to study every passage in piano playing from the separate viewpoints of adjustive and dynamic actions. The pianist must know exactly which keys he wishes to press, and how at once with the least effort to get his fingers above those keys in the proper condition and backed by the proper mechanism to play them. Any effort to play without this preparation results in muscular uses for dynamic purposes which interfere with lateral adjustments. Dynamic actions, being predominantly vertical, must occur only at the instant the playing mechanism is in position to press the proper keys. Otherwise they will interfere with lateral movements of the same levers. Different sets of muscles will therefore oppose each other, resulting not only in ineffectiveness, but in useless fatigue.

Adjustive and dynamic movements may interfere with each other, resulting in fatigue and cancellation of effort.

Recognizing as a principle that lateral-adjustive and dynamic movements should not interfere with each other, the natural order of studying a passage technically is tripartite: (1) the mental conception of the passage, including the position of the keys to be played; (2) the study of the lateral adjustments of the technical mechanism necessary to bring it over the right keys at the right time; (3) the addition of the dynamic motions (including their *preparation*) in such a manner as to press the proper amount of tone from the keys without interfering with the ease of the lateral movements *next to take place.*

Order of practicing the different elements of a passage.

Two very important remarks may be made concerning such practice: (1) The condition of all muscles to be used in playing should be that of perfect relaxation when not in use, in order that one muscle may not have to be forcibly overcome by another (wasting the force of both), and to prevent undue fatigue otherwise. (2) Tone production, during the period when the position of the keys is being

Muscles should be absolutely relaxed when not active, to prevent conflict of forces.

studied and the lateral adjustments practiced, should be very light, so as to interfere as little as possible dynamically with lateral movements before they are well learned. Afterward the dynamic effects may be added with comparatively much less effort.

Tone production should be very light while learning lateral adjustments.

CHAPTER II

The Piano-playing Levers and the Muscles Which Move Them

BEFORE analyzing more closely the uses of the piano-playing mechanism, a rough description of the mechanism itself is necessary.

The playing mechanism consists of levers and muscular forces, and the fulcrums and tendons subordinate to them.

It is to be noted first of all that this mechanism consists of four classes of things: (1) *levers*, as for example, the fingers or the forearm; (2) *forces*, the muscles which, by contracting or drawing up, pull the levers and cause them to move and transmit the forces; (3) *fulcrums*, the joints upon which the levers move; (4) the *tendons* which connect the muscles with the levers. Of these the muscles and tendons may be considered together, since the point at which the tendon pulls the lever (the point of application of the muscle force) is all important.

The most important levers are: the fingers (and their sections), the thumb (and its sections), the hand, the forearm, and the upper arm.

The most important levers are: (1) the fingers of the hand, operating from the metacarpal joint (the one next the hand), and also from the joints nearer the finger ends; if only the end of the finger should move upon the first joint, it acts by itself as a lever; the different sections of the finger may coöperate as different levers, or simply as one if motion be only from the metacarpal joint; (2) the thumb, operating somewhat similarly to the fingers, but with differences important in certain regards; (3) the hand, operating from the wrist joint; (4) the forearm operating from the elbow; (5) the upper arm operating from the shoulder. It is to be noted that the levers nearer the body can include those farther from the body as a part of the same lever if there is no motion at the junctures with those farther levers — as for instance, all the levers may be moved by the upper arm as a part of

that lever if all the joints except the shoulder are stiffened.

The muscles whose action it is most important to study are: the flexors and extensor; the triceps and biceps.

The muscles (forces) we shall consider first are the *dynamic* and *preparatory-dynamic* ones: (1) the *flexors* (benders), two muscles situated on the lower or inside part of the forearm; they shut the fingers at all joints or any joint and also move the hand inward from the wrist joint—these muscles throw the fingers and hand toward the keys when one is seated at the piano; (2) the *extensor*, a muscle on the upper side (or outside) of the forearm which exactly undoes what the flexors do—extends or opens the fingers and hand when flexed, consequently moving them away from the keys when in playing position; (3) the *triceps*, which is an extensor situated at the back of the upper arm, and straightens out the forearm when flexed at the elbow, consequently moving it towards the keys; (4) the *biceps* (a flexor), situated on the inner side of the upper arm, which draws the forearm toward the upper arm.[1] It will be seen that these muscles are in pairs, each pair consisting of a bending (flexing) force and an extending force.[2]

These muscles are in pairs, for purposes of reciprocal action.

The action of each pair is reciprocal; that is, one muscle contracts while the other relaxes, the action of one undoing the action of the other. Each lever (or in the case of hand and fingers, set of levers) may be flexed, its extensor at the same time relaxing; or extended, its flexor meanwhile relaxing. The action is much like that of a rope running over a pulley—when the rope on one side is pulled,

[1] If the left hand be clasped around the right forearm half or two-thirds of the distance between the wrist and elbow, the alternate contraction and expansion of the flexor and extensor muscles (on opposite sides of the forearm) can be felt as the fingers close and open, or the hand makes similar movements from the wrist. The biceps may be easily felt, the triceps with somewhat more difficulty, usually.

[2] In the case of hand and fingers the two flexors act very much as one, but are *attached* at different points.

the other rope moves toward the pulley reciprocally. The upper arm has muscles, corresponding to flexor and extensor, situated along the breast and back. As their action is instinctive, we shall not need to consider them—devoting our attention, instead, to the action of their lever, the upper arm. The same may be said of the muscles and uses of muscles which move the levers in lateral adjustments, such as the *interossei* of the hand. The same levers which are used dynamically are subject to lateral motions, but as these motions are not subject to resistance like that of the piano, the player is not so apt to make them awkwardly or ineffectively, and there is no need of analyzing the action of the muscles, but only of the levers. The dynamic action of the muscles situated in the arm needs to be analyzed in order to understand what the motions and sensations of the levers should be when used properly in opposition to the forces of the piano action. When this is once learned, attention ought not to be directed to the muscles, which are mediate forces, but to the levers, which operate directly.

The actions of muscles controlling the upper arm and lateral adjustments not so important of analysis.

Every lever in the hand or arm, whether operating adjustively or dynamically, moves from a joint at the end of the lever which is nearer the shoulder. The other end of the lever, when moved, does not move in a straight line, but *describes an arc of a circle around the joint*—just as one may draw a circle around a given spot with a piece of chalk and a string. In the case of the playing lever, however, the arc is apt to be very small, sometimes so minute that for practical purposes it is a straight line. In numerous other cases, the arc described by the lever can be turned into a straight line when necessary by *compensating movements* of other levers,—as, when the forearm swings along the keyboard from the elbow its arc is turned into a straight line by backward and forward movements of the upper arm. The upper arm *changes the position* of the elbow, the center of the arc which the forearm describes.

Lever ends move in arcs, not straight lines.

Such arcs are often turned into straight lines by compensations which move their centers.

Arcs whose centers cannot be moved cannot be so altered.

When the center from which the arc is described cannot be moved, the instinctive attempt to move the lever end in a straight line being opposed by natural conditions, the result is conflict of forces and ineffectiveness. This occurs in the case of the lateral adjustments made during arpeggios and in many other such places.

This last class is very important in playing arpeggios and similar passages.

Discrimination is very important between (1) movements which describe arcs so small as to be straight lines for practical purposes; (2) arc movements *which can be turned into straight lines* by compensations which move their centers; and (3) arc movements *which cannot be changed into straight lines* because their centers cannot be moved. The last case is most important, as here conscious direction must be substituted for instinct. It will be given special treatment in later analyses of lateral and dynamic motions during arpeggios and scales, Book II, Chap. II.

CHAPTER III

The Manner in Which the Levers and Muscles Act Dynamically

THE dynamic actions of the playing mechanism constitute the greatest difficulties of piano playing. They require the exertion of considerable power, which, if not economically managed, may seriously hamper the freedom and ease of lateral adjustive motions. This weighting down and interference with distributive action therefore constitutes one of the chief obstacles to be overcome by a good technical method. In playing an arpeggio, for example, the hand and fingers move rapidly along the keyboard, and during such movement keys are depressed by the fingers. Some force is necessary to depress them, and if it is hard to supply this force the muscles which move the fingers sidewise are overtaxed, as they must not only do their own work, but also forcibly overcome the tendency of the hand to stop over the depressed keys.

Dynamic actions are the crux of piano playing.

It is thus evident that a scientific way of applying power to the keys must be sought, in order that the application may be easily accomplished. And this not only that tone may be more easily produced and controlled (implying economy in dynamic functions), but that velocity and flexibility of utterance themselves may be increased. It is not too much to say that scientific dynamic action is the desideratum of piano playing by far the most difficult of attainment, as it has been in the past the most obscure in theory.

A scientific dynamic method must be sought.

Let us use a rough illustration of how leverage is exerted in a dynamic manner. Suppose a man in a boat should throw to the shore a small stone to which a rope is attached. He holds the other end of the rope, and

Illustration of action and reaction in application of force.

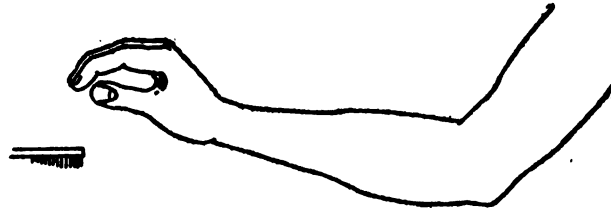
pulling upon it he easily drags the stone back towards him without perceptibly moving the boat. The stone then catches upon a heavier plank, so that the man must drag both when he pulls. By the exertion of more force he is still able to pull the plank towards him, but by reason of the increased resistance his pulling now operates to drag the boat in towards the plank at the same time. If the weight of the plank is great enough, the boat will move toward the plank as rapidly as the plank toward the boat. Suppose the plank finally is caught upon an obstacle which is too firm to be moved. If the man still pulls, though the whole force of his pull is sustained by the plank, the boat alone moves, and it will move toward the plank till stopped by the shore.

This is an example of the *action* and *reaction* of a force, and is a fair parallel of the manner in which two of the principal levers used dynamically in piano playing coöperate in applying force to the keys.

Detailed parallel of the action of the flexor muscles upon the keys, and their reaction upon the forearm.

In Fig. 1, *a*, *b*, and *c*, the piano key is somewhat analogous to the shore in our illustration. The forearm corresponds to the boat and the hand to the stone to which the flexor tendons (rope) are attached. The flexor muscles parallel the force exerted by the man. This force pulls the weight of the hand downward (as the man pulled the stone), till it reaches the key, with little effect upon the forearm. When the falling hand reaches the key, which offers a little resistance, the flexor must pull harder, and being now attached to the key the pull operates to move the forearm slightly toward the hand, just as the boat was first moved toward the rock. This movement of the forearm toward the hand is made possible by a yielding upward of the relaxed wrist. When the point of the hand carries the key down to the keybed it can move no farther, and if the flexor pull continues it will pull the forearm (corresponding to the boat) more decidedly toward the hand. The continued forward motion of the forearm

a



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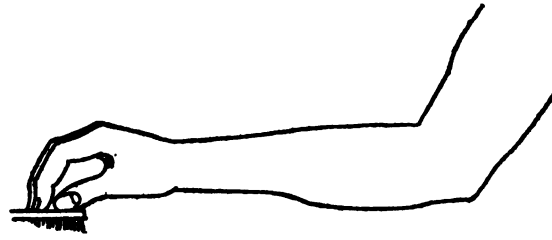

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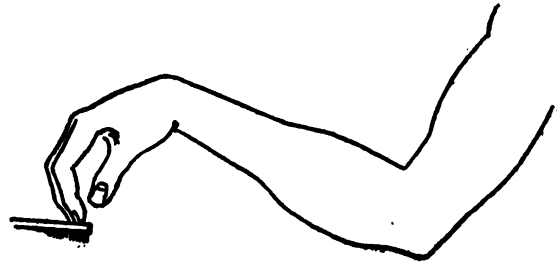


forces the wrist to bend progressively farther upward, in order to allow of the forearm's approach, and the elbow moves correspondingly forward.[1]

The action of the forearm (which depresses the wrist by weight and the extensory force of the triceps) opposes the flexor reaction. This makes the flexor action effective.

The flexors are attached by means of their tendons to the hand, and at their other end to the forearm. Their pull upon the keyboard through the hand is called their *action*, while the pull upon the forearm is their *reaction*. The reaction of a force is always equal to its action, and opposite in direction. *The dynamic muscles of the hand cannot, therefore, act upon the keys without a corresponding reaction upon the forearm.* It follows that the flexor force used to overcome the resistance of a key or key-group will have only such effect as is made possible by the resistance of the forearm to the *reaction* of the flexor force (just as the man in the boat could not pull even the light stone toward him if the boat offered no resistance to the pull). The weight of the forearm itself makes a slight resistance to the pull of the flexors and to the consequent rising of the wrist. But if any considerable flexor pull is exerted, some other force must aid in keeping the wrist from rising too rapidly to offer enough resistance to the flexor reaction. This force is easily found in the natural action of the triceps muscle, which extends the forearm from the elbow, and therefore, in the playing position, forces the wrist end of the forearm downward. The triceps action need not be strenuous, because it merely supplements the weight of the forearm, and because it is a strong muscle operating a long lever.

Recapitulation.

To recapitulate: no muscle *acts* on the piano keys without a corresponding *reaction* which in turn must be *resisted* by the weight or muscular action of some lever

[1] The exact proportion in which these motions and tensions take place is a matter of mathematics and not of technical management. The principles controlling the motions guide to correct technical procedure.

farther back towards the body, before the original *action* is effective in depressing the keys.

Using an additional illustration, the materials of which are near at hand: if one be seated at a grand piano, and, placing the heel of the hand against the front of the piano, just below the music rack, should push against it with force, the action of the force may be felt at the place where the hand impinges upon the piano. The reaction may be felt upon the piano chair. One easily understands that if the chair should oppose no resistance to this reaction, but on the contrary should retreat or shrink from the reactionary force, the action of the push would not take effect on the piano. The reactionary force, of course, goes through the chair to the floor, and through the floor to the walls of the building.

In like manner, when in playing the flexors apply force through the hand and fingers to the keys, the force reacts upon the forearm, and is carried back through the elbow to the upper arm and thence through the shoulder to the body. To these successive reactions are opposed the weight of the levers (so far as it gravitates oppositely) and when this is insufficient, it is supplemented by muscular propulsion of the lever in the direction contrary to the reaction which is to be offset.

The management of the actions and reactions at the wrist being thoroughly understood, those at the elbow and shoulder can be easily reasoned out.

CHAPTER IV

Dynamic Action of Levers and Muscles, Continued

WHEN the flexors act upon the keys through the hand-lever, if the action be made effective by the resistance of the triceps (through the forearm-lever) to the reaction, we have a dynamic action due to compound leverage. For convenience we may call this action *flexor impulse* with forearm opposition, or more briefly, flexor or hand impulse. We must observe that in this action, the fingers being in themselves levers situated at the key end of the hand, transmit the force and can modify it by independent action.

Action initiated by the flexors designated flexor impulse, or hand impulse.

A precisely similar initiation of impulse may be made by the forearm. If it be thrown downward from the elbow, being extended by the triceps, its *action* is like that of the hand when the latter initiates a dynamic impulse. As the reaction of the flexor-force was in that case opposed by the forearm, so now the reaction of the triceps (forearm) force is opposed by the upper arm. The hand now *transmits* the forearm action by opposing to it its (flexor) action. Thus the forearm action forces the wrist down, opposed by the flexor action (impelling the wrist upward) and pressing down the keys. But in the case of forearm initiative of the impulse, the forearm force is the predominant one, and (if properly used) forces the wrist below the level of the hand, the flexors not opposing enough reactionary force to quite offset the triceps action. Thus the balance and elasticity are preserved, as is necessary.

Similar initiation of force by the triceps designated forearm (or triceps) impulse. This is transmitted by flexor opposition.

Proper use of these two varieties of dynamic action must be made the basis of any good method of piano-playing. It is impossible to play the piano without making

Elastic balance between the two main dynamic actions is essential to a good technical method.

use of the hand and forearm and their propelling muscles, and all methods have done so, even when ignoring these uses in theory. But while all great artists of the present day make expert use of these actions, mostly as a matter of instinct and empirical practice, their relations and control are not properly taught, in methods and schools. The gist of their management lies in the perpetual *opposition of flexor reaction to forearm action*, whether the impulse is first given by hand or forearm, and *the delicate and controlled balancing of these opposed forces*. To fully understand their employment in coöperation with the finger actions, we must go somewhat farther in analysis and illustration.

The wrist joint may act as a valve to balance the flexor and triceps forces.

The flexors propelling the hand, and the triceps propelling the forearm, are relatively powerful forces, but they are also relatively clumsy, and not susceptible of rapid or delicate action. If awkwardly opposed to each other in flexor impulse, or if the flexors do not properly modify the triceps force when the forearm initiates the motion, undue conflict and cancellation of force occur, and stiffness and unmanageability result. To prevent this conflict and waste, the wrist may be controlled so as to act as a safety valve, or to perform an office similar to that of a carriage spring.

During flexor impulse the wrist rises, and during triceps impulse it falls, in maintenance of equilibrium.

In hand impulse the drawing forward of the forearm by the flexor forces up the wrist, and this is opposed by propelling the wrist end of the forearm downward. If the forearm should not be allowed to ascend at all, but be held down so as to keep the wrist straight, the conflict of flexor and forearm would produce a stiff wrist, and the action of the flexor upon the keyboard would be less manageable. If, however, the forearm opposes the ascent of the wrist only so long as the hand is active in throwing the hammer against the piano-string by key-pressure, and then instantly yields, the wrist ascends, and there is no undue tension or unmanageability. It is of no use to

press the key longer than the moment the piano-hammer strikes the string. For the hammer instantly falls back ready to strike again, and no amount of key-pressure can affect the tone already formed. Only enough pressure is required to hold down the key, so that the damper may not fall back and stop the tone, and (this however is important) enough to allow the weight of hand and arm to rest easily and so obtain a good purchase from which to form the next tone or tone-series. We shall see this more clearly when considering finger-action. In a similar manner, when the forearm initiates dynamic motion, which is transmitted to the keys by hand and fingers, at the moment when the resistance of the key-bed is felt by the hand, the forearm should be allowed to carry the wrist below the level of the hand, if very minutely, so that the hand may better modify and control the forearm force, transmitting just so much of it as the instinct of ear and hand approve. This spring-like action at the wrist also leaves the flexors in a more elastic condition, so as to better allow of finger action and control. For, as before noted, the flexors propel the *fingers* dynamically, as well as the *hand*.

The flexors may propel the hand for power and the fingers for delicacy. The point of control should be near the keys.

Both of the flexors are connected with each one of the four fingers, and their force may be deflected into any finger or combination of fingers at will. The flexors pull the fingers in toward the hand not only at the metacarpal joint, but also at the other two joints. But if they flex the hand at the wrist joint, much more of their force is transmitted to the keys (the hand being a larger lever and the wrist joint farther back from the application of the force) than if they flex one of the smaller finger levers. But as there is a gain in *power* by the use of the hand, there is a gain in *control* by the use of the finger. An illustration will make this clear.

Take hold of an ordinary pencil near the end farthest from the point, and try to write with it in the usual manner. Then grasp it near the point, and the control over

Illustration of control of force near the point of its application.

it will be found to be much more minute. While the fingers, therefore, cannot transmit so much of the flexor force as the hand, *they can control the portion transmitted far more delicately.* It is this superiority of control which makes a finger capable of more velocity, as well as superior in capacity to modify the amount of force.

The fingers should act from all their joints, controlled from the finger-points.

From the foregoing illustration it will begin to be evident why the finger action should not be restricted to the metacarpal joint, but the finger be flexed naturally towards the palm at all the joints. Just as the finger working from the metacarpal joint has better control than the hand, so the joints of the finger nearer its point (refer again to the pencil illustration) have more control than the finger when flexed only at the metacarpal joint.

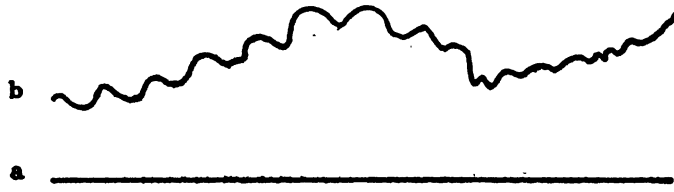
The wonderful natural provisions for combining the action of levers which apply power in the mass and those which apply it delicately and in detail.

As there are four fingers, not to mention the thumb, which can be used serially, it is self-evident that far more velocity can be secured by the use of the fingers than by hand or forearm. We have thus, as a part of our dynamic equipment, a set of levers susceptible of great velocity and minute control. But if we try to produce any considerable amount of force by their independent use, we find that we can do so only with great exertion and fatigue, and at the expense both of velocity and control.[1] We also have, as another part of our dynamic resources, muscles and levers of large power, but only susceptible of velocity at the expense of their power. Does this not point towards such coöperation in the use of these resources that the force shall principally be furnished by the more powerful levers, and the velocity and control mainly by the smaller and weaker levers? Such coöperation can be effected in a manner nothing short of marvelous, so perfect is the natural provision for it.

Let us picture the amount of force necessary to the

[1] By the law of the transformation and equivalence of forces we know that motion cannot be transmuted into force without loss of motion.

production of a passage upon the piano as in Fig. 2, the lower line (*a*) representing zero, and the distance from it to the line (*b*), amounts of force varying as the distance.



If we now draw a line (*c*), we note that the space between (*a*) and (*c*) will include most of the force, and the space between (*c*) and (*b*), most of the more minute variations in force.

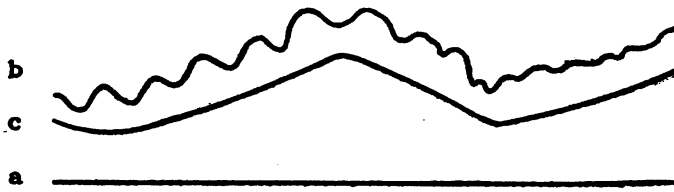


Illustration of the total force used in a passage, as related to its modifications.

In playing such a passage it would be natural, if possible, to produce the amount of tone *a*—*c* with larger, even if more clumsy means, and the amount of force *c*—*b* with means which could more perfectly modify the degree of force. If we do not do so, but try to produce the whole force and its modifications with, say, the more powerful and clumsy mechanism, we shall not be able to produce the modifications described by the line *b* properly. Or, if we use a mechanism which can produce these more minute modifications, we shall either have to sacrifice them or produce a total force which is either too small or produced with too great difficulty.

Such a state of affairs we actually have in our playing mechanism. In the hand and forearm levers, operated by

Application of the illustration.

flexors and triceps, we have powerful means of producing tone, but not susceptible of rapidly or delicately modifying tone. In the finger levers we have means of rapid distribution and minute modification, which qualities will be sadly interfered with if we endeavor to produce large tone with them alone.

We must seek the best means of combining these dynamic factors so that each shall do the work for which it is naturally best fitted, and be spared that which it alone would do awkwardly and with a lack of economy.

CHAPTER V

Some Combinations of Dynamic Mechanism

WE noticed in the foregoing that the flexors propel the dynamic action of a single finger upon a piano key, and that such action, while not powerful, is subject to minute variation, especially if controlled by the action of the lever nearest the finger point, while the finger is flexed at all the joints. To such a flexion a bending inward of the hand at the wrist joint may be added. This whole combination is effected in a wonderfully economic manner by the flexors alone, acting upon levers of different lengths, all moving and exerting dynamic power in the same direction. As a result of such a marvelous combination, we have all the power of the flexors, operating from the large hand lever, shaded down from smaller to smaller, and the control shifted nearer and nearer to the point of dynamic action. *All* the action of the flexors *finally reacts* upon the forearm, whose resistance, modified by the triceps, makes the flexor force effective at its point of *action* on the keys. But these beautiful mechanical provisions are not the whole. We may shift the power, transmitted to the finger by the hand, to any other finger by merely pressing the latter upon a key and at the same time continuing the flexing of the hand upon the wrist. As before, the hand contributes most of the power, and the amount of this power *transmitted* depends upon the finger flexion, controlled toward the point. In this manner we can distribute the hand power to a series of keys, delicately controlling its application with the finger-levers. Larger modifications, of course, can be made with the hand itself.

The manner of combining finger action with hand action. Final reaction on the forearm.

A group of tones made in this way will naturally be be-

The beginning of a group produced by flexor impulse, with action and reaction described.

gun by a flexion (stroke or pressure) of the hand, with or without finger-flexion. When the hand reaches the keybed, the flexor reaction upon the forearm pulls it towards the hand and impels the wrist upwards, while the forearm action resists this motion by just enough force to give the desired amount of tone, still yielding elastically upward. During this action, the pressure on the keys is shifted from finger to finger, and the fingers add their own characteristic modifications to the (might we say) staple amount of tone created by the hand.

Forearm impulse as carried out by action of hand and fingers.

In triceps (forearm) impulse, the tone group is begun by forearm initiative. The forearm is propelled downward by weight or triceps force toward the keys, and carries the hand and fingers with it, the flexors being in a realxed state. When the hand (the finger-points) reaches the keys, it transmits only so much of the triceps force as the instincts of ear and feeling demand, and the force is shaded down and refined as to control by each of the finger-levers, to the fingerpoint. The valve-like movement of the wrist, however, instead of being upward as before, is here downward, since the forearm is now initiating the dynamic motion. The forearm in this case simply acts as the hand did before, only now the active motion is begun farther back toward the shoulders by a longer and more powerful lever. The hand, opposing its action to that of the forearm, modifies the latter, as the fingers do the flexor force. The *modification* is begun in the hand and shaded down through each lever of the fingers, instead of beginning in the fingers, as in hand impulse. In the more powerful chord effects, the amount of force is usually more easily produced by forearm impulse than by hand impulse There is, however, a much more frequent and equally important use of forearm impulse. This is its employment in the course of legato passages.

It is possible to continue a flexor initiative (hand im-

pulse) through a rather long group. This is done by learning to continue the flexor action and forearm resistance through the group, with very slight motions of the wrist progressively upward with each tone of the group. It is also possible to continue forearm impulse through, perhaps, a somewhat shorter group, by elastic control of the downward yielding of the wrist, cushion-like, so that the wrist does not go down too rapidly. But it is unusual, because unnecessary, to play more than a short succession of tones with one initiative; for changes from one impulse to another during a group are very simply and naturally made. Without remitting the pressure of the hand upon the keys, we change one impulse into another by a mere reversal of the direction of wrist motion—from downward to upward, or from upward to downward as the case may be.[1]

Continuation of hand or forearm impulse through groups of tones.

But there are places in every passage where the upward and downward motions of the wrist (and consequently the hand or forearm impulse) may be more naturally reversed than at other places. To point these out a slight digression is necessary.

Experimenting, we find that while it is easy to begin with a forearm impulse a group of tones articulated by the fingers, as soon as the wrist is carried much lower than the level of the keybed it becomes difficult to play with the fingers while the wrist is still descending — difficult to transmit the forearm pressure, in other words. On the contrary, we can play with the fingers quite effectively while the wrist is rising till it is considerably higher than the keys, — can still transmit the hand pressure well. So that we may say it is easier, in a great majority of cases, to play *with the fingers* during *flexor initiative*

In a series of groups played by flexor and triceps impulses, occasional alternation must occur. There are natural places for such changes.

[1] We cannot in any case, of course, transmit more force to the keys than the flexors can exert, whether initiated by triceps or flexors. They cannot oppose to the keys, in case of forearm impulse, any more force than their own.

(upward wrist motion). Trying now the thumb we observe that it is much nearer the wrist (and consequently nearer the forearm) than are the fingers. Therefore it cannot easily play while the wrist is high, and can much more easily play while the wrist is low than can the fingers. The thumb, too, is not played dynamically with the flexors, but with an extensor of its own. While this extensor can act on the thumb in combination with hand pressure by the flexors, yet it combines even more easily with the triceps (which is also an extensor) during *forearm* impulse.

Flexor initiative used for the larger part of the time.

These facts make those tones which are played by the thumb the natural places to reverse to forearm impulse, and the tones immediately or very soon succeeding, the natural places to return to hand impulse. Flexor (hand) impulse is thus seen to be used more naturally during far the larger part of the time, and this is well, because it is on the whole the more easily controlled.

Plausible objections.

A list of apparent objections here obtrudes itself. Does this procedure not give a disagreeable jolt every time the thumb is played? Must one throw the wrist downward at every place, in a rapid passage, where the thumb is played? How is it possible to make all these changes in velocity passages? Such queries are both natural and pertinent, but easily answered by a little experiment.

Objections answered.

In the first place, we are far more likely to get thumps and awkwardly controlled tones from the thumb when it tries to give all the necessary tone by its own force, unsupported by a larger dynamic muscle and lever. It is incontestibly true that this is the cause of most of the awkwardness of the thumb, — that it is not properly supported. A little practice will make possible the most delicate control of triceps force by the thumb. Again, while it is highly profitable to practice all passages, especially while learning, with very large and exaggerated motions of the wrist (combined with the utmost possible

relaxation), and with many such motions, yet this ought to be done only very slowly, and a different mode adopted for faster playing. It will soon be noticed that the faster one plays the larger the groups one may take with a single hand impulse, and that in these groups, frequent thumb keys may come without reversing the impulse. When expertness begins to arrive, one learns to make the gradual up and down motions of the wrist very slight, even during long passages, so that they become graceful and almost unnoticeable undulations, made[1] with a most delightful sense of mastery, control, and kinship with the keyboard.

Quantity of wrist motion should be minimized.

If during a legato group the wrist gradually rises, it describes an arc around the point of the hand. The end of the forearm, at its juncture with the wrist, consequently follows in this arc, the elbow being thereby drawn forward and slightly upward. When the wrist reaches a certain elevation, it becomes progressively more difficult to press the keys with the flexors, inasmuch as the tension of the hand is changing its direction to one more nearly *along* the keys than down through them. The opposition of the wrist, for the same reason, becomes less effective as the wrist passes beyond a certain elevation. Consequently there is a point, if the wrist should rise so high, near which the opposition of the forearm to flexor reaction should be increased gradually, until as the point is passed, the forearm action becomes preponderant, and is itself the controlling impulse, the hand transmitting instead of initiating the force. As dynamic action, when articulated by fingers, is more manageable if initiated by the flexors, it follows that the player should endeavor to keep the wrist from rising too high ordinarily, and to this end lower the wrist as deeply as is feasible (but not exaggeratedly, in actual playing) at each tone played by the thumb.

If the wrist rises very high, forearm action should become preponderant.

One must learn to produce the proper tension with as

[1] As Mason intimates, Touch and Technic, Bk. 1, Sec. 27.

Groups rapidly played require fewer changes of initiative than when played more slowly.

little motion as needed—and the amount of motion can be very materially minimized.[1] It is a valuable principle that the more slowly a group is played the more changes of initiative are profitable; the faster it is played the fewer changes are necessary. It would be possible, for instance, to play a scale so slowly that it would be profitable to give a special impulse (from hand or forearm) to each tone, although this would not necessitate a reversal for each tone. As we double the rapidity, an impulse for each two tones would be both easier and more effective; then, the velocity being again doubled, one for each four, and finally one initiative for a long succession of tones.[2]

[1] Care must always be exercised, in these operations, not to use muscular force except as an adjunct to weight (as for example triceps force to supplement the weight of the arm as transmitted by the forearm). This will best be accomplished by thorough relaxation of all muscles not in use, and attentive sensitiveness as to the amount especially of *resistance to reactive force* necessary.

[2] "The Groundwork of the Leschetizky Method," by Malwine Bree, has the following passage (ed. G. Schirmer, p. 29): "When a strong, full tone is to be brought out legato in a catilena, the strength of the fingers does not suffice, but must be reinforced by wrist pressure in the following way: Touch the key very lightly and force the finger to press it down deep (*sic*)—without losing contact with it—by means of a swift upward movement of the wrist; at this instant, wrist and finger joints must be firm. The same effect may be obtained by a rapid down stroke of the wrist."

These are, it is evident, uses of what we have styled flexor and triceps impulses, manipulated in an embryonic and imperfect way to bring out what I have styled "salient tones" in Book II, Chap. III, where I show how better to coördinate the use of the finger with the hand.

Apparently, while such uses of these impulses on "salient" tones, and in playing octaves (*vide* the "hoch" and "tief" of Th. Kullak) are quite common among good pianists, their systematic employment in passages, and particularly in velocity, has been less frequently attempted. There are, however, at least three very important exceptions among pianists and theorists of the first rank. Adolph Kullak gives explicit empirical instruction for their use in "The Æsthetics of Pianoforte Playing" (2d edition, 1876, ed.

G. Schirmer, 1895, pp. 153–155). This instruction is theoretically quite imperfect, owing to lack of understanding of the physical principles involved. William Mason, in "Pianoforte Technics" (O. Ditson, 1878) Chap.I, Sec. 4, and in "Touch and Technic," Bk. I, Sec. 26, has given the materials from which he undoubtedly derived a successful practical system of coördinating the flexor and triceps, without thorough theoretic explanation.

Had these two writers developed the scientific principles of which they made practical use, the state of piano teaching would be vastly superior to what it is at present. For the third exception, see my note on Scharwenka's teaching, in Book II, Chap. III.

CHAPTER VI

Lateral Adjustments

LATERAL or horizontal adjusting movements being actions which demand comparatively little energy, it is usually sufficient to take into consideration the levers which make them, and not the muscles which move those levers. For the same reason it is much safer to leave these movements to instinct than it is the dynamic actions. There are, however, a few exceptions to the latter statement. These are due principally to a single cause —the fact that instinct sometimes makes the effort to move a lever in a straight line when it really moves in an arc, as we saw to be the case with all levers of the playing mechanism. When this is the case, and when the arc cannot at the same time be altered into a straight line by instinctive compensating movements, the curved movements (arcs) must be analyzed and practiced consciously until instinct controls them as curves.

Adjustments are more safely left to instinct than are dynamic movements. Exceptions noted.

The levers capable of lateral adjustments are:

1. The fingers, describing arcs sidewise from the metacarpal joints alone as centers.

2. The thumb, describing arcs or combinations of arcs from all its joints as centers, *in* under, and *out* away from the hand.

The levers making lateral adjustments.

3. The hand, describing an arc sidewise from the wrist as a center.

4. The forearm, describing an arc from the elbow joint as a center.

5. The whole arm, describing an arc from the shoulder as a center.

6. The body, describing an arc from the hip joint as a center.

The larger adjusting levers must carry and freely support the smaller levers which control adjustments more minutely.

In making a lateral adjustment, almost always several levers coöperate with each other. But as in the case of dynamic action the larger levers furnish the major amount of force, so in lateral adjustments the larger levers accomplish the greater part of the distance, carrying the shorter levers which control the exactness of the adjustment. For example, in an upward skip of a tenth with the right arm, some movement would be made by the upper arm, but the principal movement to the right would be made by the forearm, while the exact key to be struck is selected by minuter motions of hand and finger.

These movements are coördinated instinctively, though the coöperation may be infrequently improved by mental analysis and re-apportionment of the relative action.

Compensatory adjustments are those which alter arcs into lines having the direction desired.

A different kind of coöperation may be seen by noting again the same upward skip of a tenth described above. When the forearm moved up the keyboard ten keys, its movement was in an arc with the elbow as center; but the keyboard is a straight line. The elbow was instinctively moved slightly backward or forward (or both in turn) during the arc motion, to alter the arc into an approximately straight line, by moving its center. Such an action is called a *compensating* movement. In all horizontal adjustments of any breadth the upper arm, moving backward and forward from the shoulder as center, plays a very important part in making these compensations, since it moves the center (the elbow) from which the forearm describes its arc. The compensations are, however, also made by other levers. The complexity resulting from so many direct and compensatory coöperations in a single adjustment is so great that in most cases the whole movement is best left to nature, the guiding principle being that the instinct of the lever nearest the keys should determine the amount and direction of the motion. In other words the finger-points should lead, and the other levers transport and support them with the utmost freedom.

Lateral Adjustments

When arcs cannot be altered by compensating movements, conscious direction of lateral adjustments is necessary.

The exception to this, as previously mentioned, is in cases where the arcs described by certain levers cannot be turned into straight lines by compensatory movements of other levers. Cases of this kind occur when a finger-point is itself the center of a circle, an arc of which is described around the finger-point by the wrist, or wrist and forearm. While the finger, by elongation or contraction (at its joints) may furnish some compensation towards turning the arc into a straight line (or at least making the circle of which the arc is a part larger and the curve consequently less abrupt) such compensation is only partial, and arc movement must take place. Passages where the thumb goes under the fingers, as in arpeggios and scales, furnish such instances, and similar ones occur at the passing of the hand across the thumb. They will be taken up in detail in a later chapter, as they form a department of piano technic little understood, yet one in which the application of correct principles would immensely lighten the labors of the executant.

CHAPTER VII

Rotary Motion of the Forearm, and Its Uses

Rotary motions of the hand are from the elbow joint.

AN application of force not yet considered, as unnecessarily complicating (up to this point) dynamic analysis, is the rotating motion of the forearm from the elbow, and with it, of course, the hand and fingers. The hand cannot turn at the wrist, nor be held unturned when the forearm rotates, and so must be rotated by it.

Preliminary analysis of the movement.

Hold the arm straight, or better for observational purposes, bent at the elbow. Then close the hand as if on a door knob. Revolve it as if you were turning a door knob, and you will have made the kind of motion we are considering. The forearm moves as if it were pivoted at the elbow; but when in playing position at the piano, the thumb side of the hand is much more easily revolved upward and outward than it is inward and downward. It is impossible to revolve it far enough inward to turn the back of the hand under.

This action is one of the most useful in piano playing. It was well described by Adolph Kullak in his book, "The Æsthetics of Piano Playing," but must have been used at least as early as Beethoven's time, as many passages in the sonatas cannot be performed competently without it.

Directions for and uses of the movement.

Take again the playing position at the piano, placing the hand on the keys so that the thumb and fifth finger control a sixth, upon the white keys. Revolve the forearm back and forth and note that the revolution throws the thumb and fifth finger alternately each against its key. If dynamic force were added to the motion, by for example flexor impulse, the alternate rotation would serve to apply the force first on one key and then on the other.

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Indeed the rotation itself, without other dynamic impulse by flexor or triceps, throws some force upon the keys.

Another illustration.

To make the motion clearer, take a long pencil, thrust a pin transversely through the rubber at one end, and take the other end, at the very point, between the ends of the thumb and forefinger of the left hand; with the right thumb and forefinger, take hold of the pencil at the middle, and revolve it back and forth. The pointed end corresponds to the joint of the forearm at the elbow, though it is more perfect. The two ends of the pin, sticking out on either side at the other end, correspond to the thumb and fifth finger, and are rotated with the forearm (the pencil) back and forth, independently of any action of their own.

Broken chords and octaves are facilitated by rotation.

This rotary motion of the forearm has one of its principal uses in the alternate articulation of broken sixths, octaves, or such other intervals, and of applying force exerted dynamically by the hand and forearm (in the manner explained in previous chapters) to the keys. The very rapid passages (especially in the left hand) of broken octaves, such as the sonatas of Beethoven and Clementi abound in, indicate clearly the use of such rotation. Also, such passages of broken chords in left-hand accompaniments as the following:

Its use in other passages.

But modern use does not stop at such employment, and uses the rotation to help the accent in rapid passages consisting of groups like the following, instead (we will say) of the employment of special hand or forearm impulses (up or down wrist).

In such a passage, in group 1 the hand would revolve gently toward the thumb, thus elevating the fifth-finger

side of the hand. At f sharp in group 2, the hand would revolve sharply in the opposite direction (thus articulat-

ing that key with an accent), and immediately reverse the rotation toward the thumb (more gently) during the other three notes. In groups 4 and 5 the accent is with a rotation toward the thumb, and the rotation thumbwards in group 3 should be slight, so as to save a greater quantity of the rotating room for the accent on the first note of group 4.

After such uses as the foregoing, it is apparent that rotation of the forearm is useful in almost all kinds of running passages, but only after it has been practiced so efficiently that it has become automatic and self-adjustive. As a carriage spring does not act until the wheels roll over a stone, so rotary motion, when automatic, allows the irregular heights and reaches of the keys and the uneven lengths of the fingers to come into conflict with each other as the hand is (so to say) wheeled along the keys by the arm, and the jolts and inequalities are annulled by the loose turning back and forth of the forearm in the elbow joint—a turning as much due to mere mechanical obstructions (alternating with vacuums) as to muscular instinct, and perhaps less due to conscious direction than either.

Automatic rotation serves to compensate irregularities of the keyboard and fingers.

In utilizing rotary motion in legato groups, however, the general rule is that when the keys of the hand-group run toward the little finger, the rotation of the arm is also in that direction; when thumbwards, the rolling is toward that side of the hand. If a skip is accompanied by rotation toward its last tone, the rotation of the arm continues slightly after the key has been depressed, the

Slight excess of rotation proper, after depression of key.

finger-end upon that key being utilized as a wheel. If the skip is toward the thumb, the latter cannot be used as a wheel, but the hand revolves slightly inside the thumb, by allowing the metacarpal joints to sink toward the keys on the thumb side of the hand, while the rotation elevates those on the fifth-finger side. Such slight excess of rotation is useful, like the similar excess in wrist undulation, to prevent stiffness and "hard" tonal effect.

Wide rotations are unnecessary.

It is not necessary to make wide rotations, as rotary motion is used more as a vehicle which aids the application of force than as a dynamic instrument itself.[1] By its use the need of raising the fingers from the metacarpal joints is often minimized, especially in skips, as the rolling of the hand raises the finger which is to play very easily and sufficiently above the keys.

Capacity for inward rotation should be increased.

As before noted, the fifth-finger side of the hand is elevated by rotation with much more difficulty than the thumb side. A chief object of its practice should therefore be to increase the amount of rotation on the difficult side. As the effect of other motions, such as the raising of the thumb or the wrist, is apt to be confused with rotation, its preliminary practice is best done without any other movements. The wrist should be kept level with the metacarpals and not allowed to fall or rise. The bone of the wrist on the fifth-finger side of the arm, which usually protrudes somewhat, is a good index to watch for the amount of rotation, because it belongs to the arm and not to the hand, which might be substituting other motions. The revolution of this bone brings it alternately under and over the opposite side of the wrist without otherwise changing the wrist's position.

[1] One is also stringently cautioned against the too exaggerated or incessant use of rotary motion, on the ground that it may often militate against the most effectively sensitive use of the wrist undulations in hand and forearm impulse. The best process, of course, is to practice each kind of technic till its use becomes unconscious, and then leave the matter mostly to instinct.

Forearm Rotation

Rotation combined with the dynamic actions.

In actual playing, rotary motion is combined with all the dynamic actions. As, however, hand and forearm impulses elevate and lower the wrist, when used in combination with rotation, either the rotation or the undulation must be somewhat moderated. But every rotation toward the thumb, if the tone is to be at all prominent, should be accompanied by at least minute lowering of the wrist with forearm impulse, and conversely, rotations from the thumb to the fingers should be accompanied by hand flexion, and consequently slight elevation of the wrist.

Rotation is valuable for equalizing the fingers.

Rotation outward is a valuable means of equalizing the shorter and weaker fourth and fifth fingers with the others. Combining outward rotation with hand impulse upon tones which these fingers play, often gives them a sonority and ease of production otherwise impossible.

BOOK II

Application of the Principles in Detail

CHAPTER I

The Beginning and Ending of Passages, and the Production of Isolated Tones

ALL legato passages of single tones begin with an attack (not necessarily forcible) upon the key the depression of which produces the first tone. The dynamic means of producing this first tone should be such that its volume and quality are as much under control as possible. Such control is best secured by using a powerful lever (and therefore little exertion) whose force can be applied in a manner easily modified. These requisites point at once to the use of the forearm impulse, modified (when transmitted) by hand and finger flexion.

When there is sufficient time, passages are best begun with forearm impulse.

Whether the amount of tone required is fortissimo or pianissimo, the modified forearm impulse will be able to control the volume certainly as well as, and in many cases better than, the hand impulse, if there is sufficient time at the moment in which to make the greater motion implied by the forearm impulse and its preparation. In many cases there is not enough time, as when one passage very quickly succeeds another, and in such cases the passage must begin with a flexor impulse.

The force of the forearm impulse is easily modified for tonal control.

When it is desirable to begin with a forearm impulse — say at the beginning of a composition — the forearm is elevated at its wrist end, and the flexor and extensor muscles, controlling the hand and the fingers, completely relaxed so that they hang loosely. The height to which the forearm is raised depends upon the amount of force desired to be delivered by it, but not often higher than (in the great majority of cases not so high as) the length of the hand above the keys. If higher, uncertainty will result, particularly if a black key is to be played. As the

Manner of initiating a passage with forearm impulse.

Means and manner of modifying the impulse, after initiation.

forearm begins to descend, so that the proper finger reaches the key, the flexor begins to contract so as to oppose its reaction to the forearm, and deliver its action upon the keys through the hand.[1]

Modification of the impulse continued.

The hand will possibly not deliver the whole forearm force, but will let the forearm carry the wrist downward more or less rapidly, according to the proportion of the force its more delicate instinct feels proper to transmit and the fingers further modify the remainder in a similar manner. Thus there is probably movement at all the joints, from the elbow down—saying nothing of upper-arm motion which the forearm *reaction* causes. While the player will not consciously initiate more force through the forearm impulse than is needed, yet some modification is usually necessary. If a great degree of force is so initiated, the increased resistance of the flexors will of course cause the wrist to be more tense, but this must never proceed so far as absolute stiffness.

The hand impulse should be used when lack of time would make forearm impulse awkward.

When there is not sufficient time at the beginning of a passage to make a forearm impulse easily, the hand impulse must be used. Whether the volume desired is pianissimo or greater, the hand lever should be used, and modification be made by greater or less tensity of the finger levers. The mere inertia of a piano key bears so large a relation to the power easily exerted by a finger that even a very small tone ought not to be produced by a finger unaided. If this be done, the application of the

[1] It is to be understood here and throughout that the forearm should not deliver muscular force upon the keys when weight, or weight added to impetus, will suffice—provided the impetus does not require too wide motion. If the forearm should so deliver muscular impulse instead of available weight and impetus, the latter would have to be cunteracted, making necessary the use of other muscular force in opposition to the triceps force, and from this conflict of forces waste and ineffectiveness (making itself apparent as "stiffness") would result. By "forearm impulses," therefore, the use of the weight of the arm is to be understood, *plus* necessary triceps force, both transmitted by the forearm.

force by the finger is likely to be in the nature of a hammer-like blow, which to a sensitive ear does not produce the most musical effect, especially if there be a series of such blows; nor can the fingers then control the volume and quality of the tone well, because utilizing most of their energy in the active delivery of force. If instead a somewhat slower motion of the finger is used to begin a phrase, ending in a firm pressure, the effect is not good upon the muscular elasticity necessary for subsequent tones, unless the player's fingers are unusually large and powerful.

Similar considerations govern the production of isolated tones.

The foregoing would indicate the proper course in the production of isolated single tones—if the spaces between them are such that leisure is given for the easy preparation and delivery of a forearm impulse, it should be used; otherwise a hand or hand-and-finger impulse.

Impulses should be delivered slowly by strong muscles rather than rapidly by weaker ones, for better control.

Sometimes detached tones occur rather too slowly to be performed as if they form a staccato passage, but too rapidly to allow of full relaxation of the flexors between the tones. In such cases forearm impulses may be repeated without completely relaxing the flexors between strokes. The same thing may be done sometimes between two passages or phrases where there is a very brief disconnection. The pianist must therefore learn to completely control the *amount* of relaxation of the flexors, as well as of other muscles. While absolute relaxation should be the rule for all muscles when not in use, there may easily be too much relaxation of either flexors or triceps during a dynamic impulse. All impulses should be as much in the nature of pressures as possible, and as little like blows as may be, to the end of better control. If the flexors are too relaxed during a forearm impulse, the stroke of the forearm must be too rapid and cannot be so pefrectly modified. While this is true, *preliminary* practice of all passages with exag-

Control of the amount of relaxation (and tension) of the muscles should be acquired.

gerated relaxation of all possible muscles is of very great benefit.

Release of the keys at the end of passages.

The ending of passages, in so far as treated of here, has to do only with the manner of release of the key which has produced the last tone of the passage. Where there is time enough, the release should be made first by the taking away of the forearm force (both weight and triceps action)—in other words by first raising the forearm at the wrist; and following this instantly, there should be release by the flexors (hand and fingers), leaving the hand hanging from the wrist in the same position which precedes a forearm impulse at the beginning of a passage. When the succeeding impulse comes very quickly it may not be best to relax the flexors completely. When there is so little time as to make the slower forearm motion impracticable, the flexors may release their pressure first, and the *extensor* then lift the hand from the key. The general principle is that the passage should be ended with the *dynamic* mechanism in the best position and condition to begin the following phrase.

CHAPTER II

Legato Arpeggio Passages

PASSAGES containing arpeggios are among the most difficult of those formed of single tones. Since they also contain elements the understanding of which will make plain the management of other difficulties, their consideration is proper here.

Arpeggios contain characteristic difficulties.

We must first notice that an arpeggio founded, for example, on a triad, or common chord, consist of two or more groups, each of which the hand could play while in a fixed position. For instance, if the arpeggio is ascending, and consists of the tones *c e g*, *c e g*, *c e g*, the keys *c e g* may in each case be played with the hand in a comparatively unchanged position. For want of a better name we may call such a group a hand-group. To play such a hand-group is a relatively simple matter. The characteristic difficulty of the arpeggio is to join one hand-group to another in such a manner that the tone volume and legato are not affected, and the required velocity effected without undue fatigue. The dynamic necessities, in other words, must not interfere with lateral adjustments which join one hand-group to the next. To see how much of the difficulty is due to the dynamic action, one has only to go through the motions of playing an arpeggio without pressing down the keys, and afterwards to use dynamic pressure. We must, then, learn the best methods of control of both the lateral adjustments and the dynamic action for the special case of the arpeggio. Let us begin with the lateral adjustments.

These difficulties occur at the juncture of groups.

Suppose the first hand-group of *c e g* to have been played by the thumb and first two fingers of the right hand. The stretchings apart of the fingers to do this

There are three main adjustive factors in joining one "hand-group" to another.

constitute easy and natural adjustments. After the *g* has been played, suppose the thumb to have remained approximately above *c*. It must, in order to play again, move to the *c* an octave higher. But it must do this while the third finger is still holding down *g*. Three actions can aid in the adjustment. The thumb can move under the fingers, the third finger may elongate by relaxing its joints, and the wrist can move toward the new key. Let us suppose the whole adjustment to be made by the last method. Dose the wrist move in a straight line up the keyboard? Evidently not, because the third finger is holding *g*, and its point is therefore the center of a circle. The wrist can only describe an arc around this center, not a straight line. By going through the action, and noting the position of the wrist at its beginning and ending, we see that it is nearer the keys at the ending, and that the arc described is somewhat as in fig. 6.

Movemt of the wrist in an arc whose center is a finger-point.

Obviously, if an effort is made to move the wrist in a straight line instead of in this arc, the wrist will nevertheless move in the arc, but at the expense of a strain on both the muscles causing the lateral movement, and on the flexors which are holding down the third finger. The velocity and ease of the lateral movement and the control of the triceps (which is opposing the flexors while they press the hand and third finger on *g*) in its approaching impulse upon the thumb, are all seriously interfered with. Consequently the arc movement of the wrist around the finger-point (which acts as a pivot) must be consciously directed until it becomes instinctive. The wrist is propelled in its arc by the forearm moving from the elbow, with compensating and supplementary action of the upper arm, which moves the elbow foreward and slightly to the right. Only the wrist motion, however, need consciously be directed.[1]

[1] Marie Unschuld von Melasfeld, in "The Hand of the Pianist" (Breitkopf and Haertel), an exposition of the Leschetizky method,

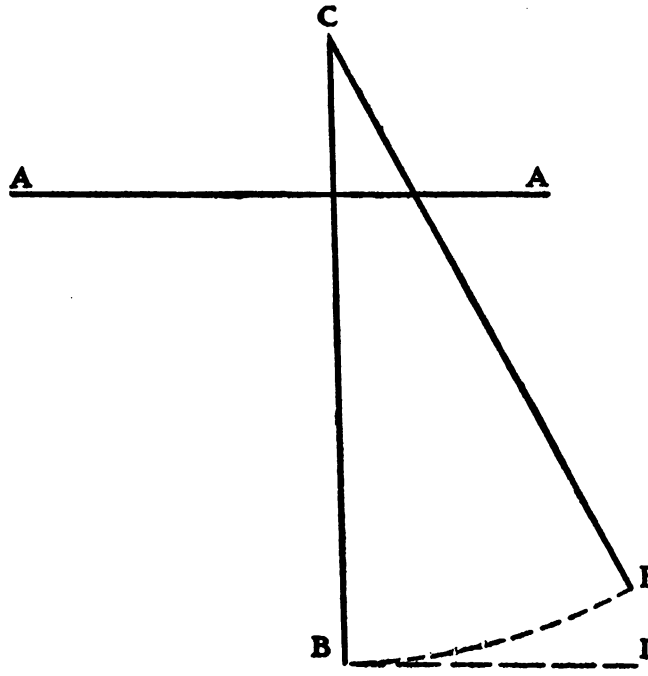
This will remove one principal difficulty in arpeggio playing. But the adjustment need not all be made by the wrist. The skip is so wide that both of of the other means—movement of the thumb and elongation of the finger—ought to supplement. The thumb should, of course, accomplish much more than the finger, whose movement should be the last supplement, so to speak, and only do what is not easily done by the other movements. The three movements in this manner coöperate, making the action much easier than if only one accomplished the whole distance. The arc of the wrist is shorter by the reach of the thumb and the stretch of the finger. Not only this, but it is better to begin a minute arc movement on the second finger as a center, thus beginning the wrist movement (as well as that of the thumb) as soon as the thumb releases its key. The lateral adjustment will thus be distributed through a longer time, with the result of better and more elastic control.

Co-operation of wrist, thumb, and finger movements.

At the release of *g* by the third finger, when the new *c* is played by the thumb, the hand itself performs an arc motion around the wrist as a center, toward its position above the new hand-group. This movement of the hand is somewhat supplemented by movements of the forearm and even of the upper arm, which are instinctively correct and should not be restricted unless unduly prominent. The lateral adjustments for each succeeding ascending hand-group are, of course, the same.

Arc movement of the hand around the wrist as center.

pp. 11–16, directs as to the union of parts of the scale, that the hand must be moved across the thumb in both directions in a *straight line*. The photogravures on the same pages show how impossible this is. She also insists that the thumb make the connections unaided by lateral or dynamic wrist movement! Edward Baxter Perry once said of the Stuttgart method that it was a complete compendium of how not to play the piano. Happily the successful artists of the Leschetizky school do not observe these hampering conditions. There are also many artists who are great in spite of, and not by means of, their technical method.



A-A, Successive positions of Thumb on C and its octave.
B-B, Arc described by center of Wrist, in taking successive positions.
C, Position of point of 3d Finger on G.
B-D, Straight line parallel with Keyboard.

Legato Arpeggio Passages

Descending, (*c g e, c g e, c g e*) the hand-group is begun by the fifth finger and proceeds toward the thumb. As the thumb is played the hand performs an arc movement around the wrist, with the thumb as support, until the fourth or third finger, which is to depress the next key, is above its key, with the hand in a position such as can support the finger flexion by action from the wrist. This movement leaves the thumb extended under the hand upon its key until the finger depresses the new key, and the arc described by the hand may be rendered smaller by moving its center (the wrist) slightly to the right and toward the name-board with the upper arm, i. e., the wrist, movement:[1]

Arc movements of the hand and wrist in descending arpeggios.

The finger about to play may also be extended minutely at its point, so as to flex again and control the tone. Care, however, should be exercised that this extension be not too great, or the finger will not offer proper support to the hand flexion. At the moment of pressure of the new key by the finger (which has been swung by the hand across the thumb), the finger becomes a pivot and the center of a circle. The wrist describes an arc around it which is exactly the reverse of the one it described in the ascending arpeggio: i. e., and the new hand-group is a repetition of the old.

The adjustive object has been, it is evident, to bring the mechanism, at each change of hand-group, above the new hand-group in such a position that the principal dynamic force can be exerted upon the keys by either a hand or forearm impulse, correctly supported by the finger joints. And this, of course, without friction or undue conflict of forces (hence the care due the pivoting and arc movements) and with the last key of each old

The adjustive object is to bring the dynamic machinery to the proper position for action.

[1] In these movements the wrist must be allowed the utmost lateral looseness, so as not to carry the whole arm with it in its action.

hand-group meanwhile under proper conditions of dynamic control.[1]

Considering the *dynamics* of the same arpeggio in ascending form, we will suppose the passage to have been begun by a forearm impulse. The succeeding main dynamic impulses will depend somewhat upon the velocity and rhythm of the passage. For example, if we should play rather slowly in a rhythm of threes, the wrist, after descending slightly below the level of the hand with the first impulse, will slightly rise during the next two notes played by the fingers. This allows their flexion to be supported by the action of the hand from the wrist joint, and brings the wrist up to a convenient position to begin the second triplet with another forearm impulse. The triplets coincide with the hand-groups, and the arpeggio ascends in a similar manner until completed.

Dynamic impulses for ascending arpeggios (right hand).

Descending (*c g e, c g e, c g e*) the triplet hand-groups are begun by hand impulses, with the wrist raised slightly. At the thumb notes (the third note of each triplet), the wrist will descend until a little lower than the hand level, in order to prepare for a new hand impulse on the accent. *This* lowering of the wrist is of course done without any forearm impulse. The wrist may at any time be either lowered or raised (loosely) without any accompanying dynamic impulse, merely as a *preparation* for a dynamic impulse requiring the *opposite* movement. If the velocity is moderate, and the rhythm in fours, the groups of four should begin (after the first one) with a hand impulse if articulated by a finger, and with a forearm impulse if articulated by the thumb.[2]

Dynamic impulses for descending arpeggios (right hand).

Variations of dynamic impulses with the rhythm.

[1] It is not to be supposed that pressure upon the key after its depression will alter the tone already formed, but the key-bed may form a support whence better leverage may be obtained for the formation of subsequent tones.

[2] Although, as noted in Book I, forearm impulses can sometimes profitably be used with fingers; especially the 5th finger, which

Legato Arpeggio Passages

Before each impulse the wrist should be slightly raised or lowered, if not already in the correct position, for the new impulse.

For example, in a somewhat rapid rhythm of sixes or eights it will be better to begin each group of six or eight notes with a hand or forearm impulse, preparing, if necessary, the requisite elevation or depression of the wrist, as before. If the wrist is left very loose, it will automatically, after correct practice, accommodate itself sufficiently at other places than the accents.

Variations on account of velocity as well as rhythm.

The details of finger dynamic action in coöperation with hand and forearm impulses, and methods of practice to acquire proficiency in them, will be examined in the next chapter.

Arpeggios on the dominant seventh or secondary seventh chords do not differ in the principles of their execution from those founded on triads. Their differences in detail will be easily grasped by the student.

is, like the thumb, short, and its end therefore nearer the wrist. There also occur cases in which it is well to use a flexor impulse with the thumb — say in staccato endings.

CHAPTER III

Scales and Other Legato Single-note Passages

WHILE scales are easier of execution than arpeggios, they were left for later consideration because the lateral arc movements of the hand and wrist in arpeggios, while similar to those in scales, are larger, and therefore more easily comprehended upon a first analysis. Diatonic scales are played with alternating hand-groups of three keys and four keys. As these keys are next each other, the distance between two consecutive positions of the thumb is smaller than in arpeggios. The arc movements of the *wrist* in ascending scales (right hand) and of the hand in descending scales (right hand) as well as the lateral movements of the thumb, and all supplementary and compensatory movements of the forearm and upper arm are therefore smaller than in arpeggios, but otherwise entirely similar. The elongation of the last finger of a hand-group in ascending is, however, not needed in scales, as the movements of the wrist and thumb are sufficient easily to accomplish the distance. The dynamic impulses are also similarly managed, it being remembered that the rhythm and velocity regulate the application of the impulses, modified as to their selection, at the accents, by the fact as to whether a finger or thumb comes on the accent.

The difficulties of scales are similar to those of arpeggios, but not so great.

With regard to the performance of other legato single-note passages, it is sufficient to apply the principles already deduced from analysis of the performance of arpeggios and scales. In melodic passages, it is desirable to bring dynamically into relief other tones than those designated by mere rhythmic accent. Such salient tones should in most cases be originated by special dynamic impulses of

Salient melodic tones.

The juncture of "hand-groups" is also the principal difficulty in many other single-note passages.

the hand or forearm — usually that of the hand, if the key is played by the finger. Two quickly succeeding hand impulses frequently make necessary a preparatory downward adjustment of the wrist between them. It is neccessary to note the hand-groups, as defined by the fingering selected, and to connect them by means of the proper arc movements and pivoting. Care must always be exercised that the swing of the hand in crossing the thumb, and of the wrist as the thumb goes under, should be far enough to allow of as vertical dynamic pressure as possible by hand or forearm; otherwise force is lost.[1]

The fingers should not be curved so much in wide stretches.

In passages where there are very wide stretches between the keys, such as extended broken chords, and more especially upon the black keys, the extension of the finger at its joints should be greater than in a passage more nearly diatonic. That is to say, the fingers in such passages should be more nearly flat or straight as they press the keys, since they thus form longer levers and the stretch between the fingers is not so great.

The seat of control of dynamic action should be in the finger-points.

This suggests a more extended examination of the action of the finger-joints in coöperation with the more powerful levers. All dynamic impulses have to pass to the keys through the fingers and thumb. The latter are thus agents, but agents which have also vital initiatory powers of their own. A finger can initiate a flexor impulse—even the very small lever at its end can do so. Such an impulse is weak but vitally sensitive as to control, partly because of being a short lever, and partly because at the ends of the fingers are networks of motor nerves which connect them intimately with those cells of the brain which direct motion. For the latter reason, motions which the fingers

[1] Hand impulses, when continued through groups, are usually best mentally conceived as *pulls* of the hand in an arc from the wrist. This because when the wrist is relatively high, the hand *is* pulling toward the forearm. When the wrist is lower, as often in the case of detached tones, or salient melodic tones, the hand action is better thought of as a stroke or pressure.

have to modify should have their conscious origin and control as much as possible in the finger-points.

Quality of action at the finger-points, rather quantity, the desideratum.

For illustration, in carrying food with the fingers to the mouth, though all the levers of the arm may move, we do not conciously direct motion from the elbow, or the wrist, or even the metacarpal joints, but from the finger-points which hold the food, instinctively. We remember that even when the fingers are articulating dynamic force originating in the forearm, they do so actively, and not reactively. These considerations lead to the conclusion that all possible vitality of action should be kept at the finger-points. This does not mean a large *quantity* of action, such as older systems advocated at the metacarpal joints. But it does mean that there must be *some* action at the joint nearest the point, otherwise control would be from a point farther from the keys. And it means that coupled with this action should be the utmost sensitiveness—the closest connection with the brain. Quality of action, rather than superabundant quantity, is here the desideratum. If the flexor action at the finger-points had to make all the tone necessary, that action would have to be very strenuous. As it has, instead, to manipulate *conditions* of tone, it must rather be very sensitive. Nevertheless, there is a mathematical relation between the power exerted by the finger levers and the larger levers farther back. If there is *more* motion and force applied by the fingers, less is necessary to be applied by the hand lever. But, as we have learned, it is unscientific to make the fingers originate great force. That is better done by the more powerful levers. But there must be *enough* action in the fingers to make the control of tone as vital as possible, and to keep the seat of consciousness, as regards control, at the finger-points.

Action of the finger from all the joints is thus required. *The grasping or prehensile action of the fingers is the most natural, as well as the most powerful.* Action *merely* at

Prehensile action at all the finger-points is necessary.

the metacarpal joint has to be *acquired.* If we make the finger move at its first joint, it is difficult to prevent its moving at its middle and metacarpal joints as well. The injunction to flex the finger from its point towards the palm is as old as J. S. Bach, as recorded of his father's method of playing by Ph. E. Bach. But later it has been disregarded for the more awkward and unmusical stroke from the metacarpal joint alone. The reason doubtless is that in Bach's time the action of the clavichord was so delicate that very little force was necessary, and this could best be applied with little other than the finger action in its most sensitive form. Afterwards the instrumental action grew continually heavier. But pedagogues of the Hummel, Plaidy, Lebert, and Raiff dynasty continued to require as little action, other than of the finger, as possible. It was consequently necessary that this action of the fingers should be increasingly more forcible, as time went on, coming finally to be of the wide, gross kind taught by the two last-named masters. The necessary coöperations and reactions consistent with the more delicate finger actions were not understood. But having now been developed, there is certainly inconsistency in adhering to portions of old systems no longer useful. We had best return to the excellent idea of Bach, supplementing it to make it correspond to modern needs.[1]

[1] In "My Musical Experiences," by Bettina Walker, occurs the following passage concerning the teaching of Xaver Scharwenka, which indicates that his piano pedagogy contains extremely advanced elements, technically — an indication borne out not only by his own remarkably beautiful playing, but by that of several of his artist-pupils whom I have carefully observed: "His comments on my technical deficiencies were, that I did not work the small joints of the fingers, and that I did not use the *hand* sufficiently in pressing out the tone. . . . He took great pains to show me how to form every single tone, using both finger-tips and wrist; . . . reminded me again to bring my finger-tips well into action." As to his reputation and character as a pianist, Miss Walker says: "Scharwenka's Conservatorium is looked

It may in general be said, that while the greater quantity of dynamic impulse should come from the hand and forearm, yet as far as possible, when the fingers are acting, they should *lead* the action. They should be in the van of it, so to speak, as if the brain should think its motor thoughts through the very finger-points. Further, there must be cultivated a sensitiveness to the *equilibrium* necessary between action of the finger-points, the hand, and the forearm—an elasticity and balance of action and reaction without which finished and artistic tonal-control is a matter of vastly greater effort and strain.

Vivid tonal consciousness at the finger points.

The proportion between the actions of the different dynamic levers is of the utmost importance.

In playing legato passages of a moderate degree of force, the finger-points do not have to be removed very far from the keys. From an eighth to half of an inch is usually sufficient. The finger should draw inward toward the key at the point and therefore at the other joints, and should cling to the key, *not slide on it*, as it descends. If hand flexion is joined to this, very large tone is easily produced.

It is not necessary to raise the fingers high.

The thumb, on the other hand, should always be flexed slightly at the joint next the nail, and the point be given a slight extensory motion and tension when played, though in connecting legato octaves the contrary action of this joint is often useful. The extensory action of the thumb corresponds to flexing action of the fingers, when dynamically used. Special practice in controlling extension of the fingers and thumb at the points, until it is automatic and delicate, will be necessary by one accustomed to another method, and this special practice will be described in its proper place.

Dynamic action of the thumb.

In playing a descending scale, arpeggio, or like passage with the right hand, the prehensile tension of the hand and fingers as they pass over the hand and thumb and

upon in Berlin as a school of virtuosity, and many of the pupils who have taken out their certificates at the Hoch-schule went to him. . . . Liszt greatly admired and esteemed him."

The feeling of keyboard-intimacy resulting from correct technic.

grasp the successive keys (thereby slightly pulling the arm towards the keys), produces a feeling like that induced by climbing "hand over hand"—a feeling of security and mastery. Expertness in combining extensor action of the thumb from the nail joint with the forearm impulse induces a similar mastery of ascending passages.

An anecdote of Tausig.

A well-known writer describes seeing Tausig once play in concert, saying that one would expect, from seeing the tremendous rise and fall of his wrists, as the massive passage rolled from one end of the piano to the other, an effect crude and bungling, and quite other than the one actually heard. Tausig, however, probably knew what he was about. But we must be careful, in emulating him, not to exaggerate any kind of motion (except with a definite purpose in practice), seeking rather elasticity, balance of forces, and equilibrium of action and reaction.

CHAPTER IV

Staccato Passages of Single Notes

The production of staccato differs little, essentially, from that of legato.

WHEN rightly produced, there is less difference between the performance of staccato and legato passages than is usually conceived. In a staccato scale, for example, one uses the same dynamic impulses of hand and forearm, and the same actions of fingers and thumb as in a legato scale. The difference is, simply, that in staccato one gives slightly more play to the extensor, which raises hand or finger from the keys, in order to allow one key time to rise before the next is depressed.

Neither fingers nor hand should be raised too high.

Only so much raising of hand or finger is necessary as serves this purpose, and while such action should be free and unrestricted, it should not be exaggerated, any more than other motions. To do so is to lose both force and control. The commonly endorsed method of raising the hand somewhat high from the wrist in order to produce enough tone by a hammer-like blow is unecessary and fatiguing. It is so for the reason that it does not oppose the reaction of the hand lever to the forearm action in a balanced manner, nor make use of the forearm impulse, properly opposed.[1] Therefore it puts too much work (and consequent strain) upon the flexors. It is as unreasonable as unduly high action of the fingers.

A large tone may be produced without wide motion if the actions of the levers are correctly proportioned.

If the pressure of the wrist downward by the forearm is properly opposed to the *reaction* of the flexor-impelled hand, and if just enough finger flexion is coördinated with this to afford vitally sensitive articulation and control,

[1] Th. Kullak, in his octave studies, has given rather crude empirical directions for doing this (*vide* his "hoch" and "tief" with their explanations), and Wm. H. Sherwood, in his edition of the Kullak etudes, has carried the matter considerably farther. But for single-note staccato the matter has been practically ignored.

neither the hand nor fingers need be raised high from the keys to give a large and flexible tone. Some extensor action of both fingers and hand is of course necessary to give room for the next flexion. The raising of the hand, especially, must be sufficient to allow enough disconnection between the tone. But this affords time for a more leisurely motion through smaller space, instead of a violent and rapid motion through a wider space. At the thumb tones the forearm impulse (down-sinking wrist) should be used even more freely than in legato, depending as before, however, somewhat on the accent and velocity. As staccato passages never have the velocity of the most rapid legato passages (the staccato could not be distinguished even if possible to play it), the forearm impulse with the thumb comes with more frequency than in legato upon unaccented tones.

Forearm impulse more freely used than in legato.

By the intelligent use of such a system, the great fatigue and the strain incident to the ordinary overexertion of the flexor muscles in staccato will be avoided, and another *bête noir* of pianism be disposed of.

A terror disposed of.

In staccato, of course, since connection between the hand-groups is not needed, none of the means of connecting them (arc motions of the wrist or hand, etc.) need be so carefully exercised. But in passages of some velocity it is well to make moderate use of them, as they give more natural and quicker lateral adjustments. As in legato, the lateral adjustments should carry the dynamic mechanism easily and quickly as directly as possible over the keys about to be played, so as to prepare for vertical and effective action of hand and forearm.

Means of connecting hand-groups not so necessary in staccato.

At this point will perhaps appear more clearly than when analyzing legato, the principle that the more vertical the position of the dynamic levers above the keys, the more can the mere weight of those levers aid in producing tone. It is unreasonable to use muscle to produce force when weight will suffice. Therefore the lateral adjustments

The use of the weight of the levers in tone production is important.

ought to be such that the finger articulating a key should be in a position which naturally supports the weight of the hand (and through it the arm), and thus applies that weight.

This argues against undue extension of the finger (when on the key) in any kind of passage, but particularly when the hand is thrown across the thumb. If the finger stretches out more than minutely in advance of the hand, it loses the weight and support of the hand. In such cases as arpeggios which require great extension between the fingers, the least of two evils must be chosen and the fingers be played in a stretched-out position, the forearm and wrist then moving the dynamic support along, parallel with the finger next to play, so as not to be a drag on the latter's action, in default of aiding it more. In such a case a greater elevation of the wrist than usual will throw more weight on the keys, and make possible a better dynamic coöperation of the forearm.

An arched position of the fingers when depressing keys supports weight and pressure better.

Such extension of the fingers as is necessary in preparing for their dynamic action should, especially in staccato, begin at the points. The finger use in staccato is more to articulate, and to control the connection with, and separation from the keys, than to add force.

Purpose and manner of finger extension.

All staccato passages should be practiced legato, as the hand and forearm impulses will thereby be learned more easily and become automatic more quickly. The staccato practice of legato passages improves the laterial adjustments, tending to bring the levers more freely into positions where their weight counts. If proper use of the correct dynamic means modifies wonderfully the difficulties of legato playing, its benefit in staccato is even more marked, resulting in an ease and economy which every such conservation of energy must effect.

It is helpful to practice staccato passages legato, and legato passages staccato.

CHAPTER V

Chords, and Staccato and Legato Double Notes, Including Octaves

THE management of the chords should be easy of consideration at this juncture, since the foregoing chapters have suggested most of the means of that management. The production is more or less governed by the tone volume desired and the leisure with which it may be prepared. The latter depends on the time elapsing since the last note, and whether the connection with it is such as to allow of the removal of the hand from the keys. If the preparation of a forearm impulse is easy, by reason of leisure and disconnection, a chord may be better managed by it.

Chord management is conditioned by tone volume and time of preparation.

A moderate degree of velocity in a passage of detached chords makes the articulation by means of hand impulses preferable. When the chords can be grouped, however, forearm and hand impulses should alternate on the accents, but every chord should be *articulated* by the hand (except perhaps the first in a passage), even when the force producing it is *initiated* by a forearm impulse. In such groups the greatest care should be observed that the forearm action at all times balances and makes effective the flexor reaction. This, with minimizing the amount of hand motion, obviates most of the fatigue usually attendant on performances of chord groups.

Combination of hand and forearm action in groups of staccato chords.

The fingers should prepare for the coming chord by forming themselves adjustively into the shape of the hand-group, and have very little action (in staccato) outside of this adjustive preparation. There ought to be, however, a grasping tension of the finger-points upon the keys forming the chord, in order to control and transmit the

Description of supporting finger action.

tone better; this also gives greater firmness. Such a prehensile *tension* cannot very well be exerted without a little previous prehensile *motion*,[1] nor this without some slight preparatory extension. But practice will make possible a very minute amount of such extension and flexion, which ought to be at the finger-points.

Legato connection of chords.

Legato connection of chords may best be effected by alternate forearm and hand dynamic impulses (a new impulse to each chord); thus lowering or raising the wrist alternately, and not releasing the grasp of the fingers on the keys which are to be quitted until the very instant of the application of the new impulse. The fingers are then quickly slipped across to the new group, the process being materially aided by the motion of the wrist. Of course the pedal will effect a legato connection between chords, and is usually used for tonal modification in any case, but there are instances where legato connection without pedal is desirable. As every pianists knows, the impression on the ear as to whether connections are staccato or legato is largely due to the manner of their articulation as regards individualization or the contrary. A legato connection by the fingers or hand, therefore, even if not so perfect in a given case as if made by the pedal, may give a better impression of legato to the ear, because the tones connected may not be so individualized.

Dynamic impulses originating further back than the triceps.

Certain modern pianists, in cases where very great volume is desired for chords, originate dynamic impulses still farther back than the forearm. I have seen a European pianist of high repute[2] originate dynamic impulses of the upper arm by raising it in an arc of which the shoulder is the center. This has the effect of bringing the hand a considerable distance from the keys before the impulse. The upper arm may also draw the elbow backward, pre-

[1] Such prehensile tension is preferable to immovably "*feste fingerspitzen*."

[2] Mark Hambourg.

paratory to its being pushed forward in combination with forearm action. The body might even be inclined forward simultaneously with such preparation of the upper arm. Still other ways of initiating power back of the triceps may be devised. While no means is to be despised which is needful to produce legitimate results, yet the simplest effective means must always be preferred by the true artist. He must judge of such matters for himself, after being sure of what he is doing.

The upper arm, of course, is constantly in motion with the shoulder as a center, and this as constantly brings into play the muscles at the back and front of the shoulder. In general, however, their activities are preparatory-dynamic, or occur in opposing resistance to the reaction of the forearm.

Application of impulses to staccato octaves.

Staccato double notes, including octaves, are of course executed like chords. They should be grouped in the same way, forearm and hand impulses initiating each group, and a slight hand stroke initiating each octave (or other double note), even those whereon a forearm impulse is placed. Exaggerated motions of the wrist are not necessary, if the actions and reactions are carefully balanced.

Tension of the fingers in staccato octaves.

In the case of octaves the extension is so wide for most hands as to make desirable some unusual means for sufficient rigidity in the fingers to properly transmit the dynamic impulse, and to keep the exact extension fixed. This is effected by flexing the nail joint of the thumb a little, if the hand is large enough, and also the fifth finger, holding them as if clamped in this position, somewhat rigid at the ends. The fourth finger should not be used in staccato octaves, its use being one of the natural means for the legato connection of octaves, hence not conducive to staccato. The alternation also renders less stable the clamp of the fingers.

As in legato octaves the fourth finger may pass to a black key across the fifth, and the fifth under the fourth

Passing the fingers over and under each other.

for a similar purpose, so double-note legato connections are often best made by the passage of combinations of fingers under and over other fingers. In so doing, if care is taken to combine the flexion of the fingers with the proper hand flexion and forearm opposition, greater ease results. When the thumb plays one of the double notes, a forearm impulse is often useful. Whether one shall be used or not may often be determined by finding whether the connection which is being made by the thumb is more difficult than the one made at the same instant by the finger; or whether the finger or thumb tone should be brought out more, thereby making control of the one which should be brought out more important. Such considerations become very serious in polyphonic playing, where the utmost flexibility of management is necessary to the individualizing of the voices.

Correct support of such connections by hand and forearm.

CHAPTER VI

Recapitulation, Suggestions as to Practice, and General Observations.[1]

Generalization of technical objects.

TO generalize the objects to be subserved by technical practice, let us briefly restate some of the aims of technic. The principal difficulty of piano playing we found to be the *production of sufficient power*, and the economical application of the power to all kinds of passages, with velocity and under delicate control. Earlier piano methods sought to get power from the means which should be drawn upon for control and velocity.

[1] It will undoubtedly be objected in some quarters that the result of such technical procedure as herein advocated would be a tendency toward the dryly mechanical and away from the artistic; inasmuch as (among the least of such sins) *quantity* of tone has always been discussed, and not *quality*.

To this it must be replied (1) that the scope of the work is limited to mechanical considerations, and that it will only be useful to those who are able to make them subservient to artistic considerations; (2) that what we know as tone quality (tone coloring, timbre, and the like) is, as far as the piano is concerned, largely a matter of tone quantity, either absolutely or relatively. Those differences which the pedal makes are, to be sure, due in a great measure to the beautifying influence of sympathetic overtones, and might properly have been treated in this volume. But they, as well as many other things, which we might have discussed, have been adequately treated elsewhere. There are also means of eliciting from a single piano tone, played without the pedal, a quality whose beauty is due to harmonics. But this results when the vibration of the strings producing that tone reaches a certain degree of power. This point is decided by the sensitive ear, but the power to produce the *quality* is limited by the command of the mechanical means producing the *quantity* of vibration at which that particular quality is given off. Tone quality may be harsh if the strings be unduly vibrated, or thin if the quantity of vibration be too small to excite all the overtones.

But what we call tone color is largely due to the relative

Misuse of functions results in practical atrophy of powers.

The result was a disuse of the larger levers and muscles of the arm, or rather an improper and uncontrolled use, since it was impossible not to make any use of them. Their correct functions were thus partially atrophied. Later, when musical and instrumental demands became insistent, the large levers were properly used by great artists, but not being thoroughly explained from a theoretical standpoint, such correct technical procedure was limited to pianists of extraordinary instinct, and to the favored personal pupils of such pianists, who were enabled to learn from the example and empirical instruction of their masters things which the latter could not always satisfactorily account for in theoretical ways. Such theory of more or less excellence as was put forth by masters like Deppe, Henselt, and William Mason (and much of it was very valuable), was disjointed or incomplete. Having a series of incomplete theories, though originated by pianists of high practical ability, in whose personal instruction the theoretical was largely supplemented by the experimental, when the theory and practice was promulgated by disciples several times removed from their sources of inspiration the results became one sided. Pupils are prone to exaggerate elements to which their own attention has been strongly drawn, and even the inventors of theories ride their own hobbies assiduously. Even with the most adequate theory the latter can very easily be done.

Methods are likely to degenerate in disciples' hands.

quantity which the different tones forming a chord or passage have with regard to the other tones. If a chord 3d or 7th be made too prominent in an inner voice or the bass, the chord sounds "hard," not rich. Similarly, by bringing out or holding back certain voices in successive chords, or a passage, and by varying and delicately balancing the relative amounts of tone, many effects of "tone color" may be produced. Strictly speaking, however, these processes are more nearly like those of a plastic artist working in black and white, or a limited range of color, than those of a painter. And they are controlled by an effective management of dynamics as directed by the ear.

Recapitulation and Suggestion

Care should be used to keep methodic technical culture catholic.

In applying the technical theory promulgated in these pages, then, care must be exercised not to exaggerate those portions of it which are less familiar. If, for instance, the application of flexor-force by the hand should habitually be exaggerated (the impulse originating in either hand or forearm), the power to apply flexor force with the finger levers would partially atrophy, and the finesse and vitality of their control be lost. In a similar manner, restriction of finger action to the metacarpal joints has resulted in loss of the valuable and sensitive control (as to both tone and velocity) of the finger joints nearer the ends. And lack of knowing how to balance the action and reaction of the forearm and hand has resulted in the inability to use those levers in their best ways, and in the compelled assumption by the fingers of strenuous functions of volume production which inhibit velocity.

Practice must be discriminating and thoughtful.

The practice of the student must therefore be of an intellectual kind. It must seek not only to develop the powers of each lever and combination of levers, but continually and sensitively to weigh the development of these powers so that one does not overbalance another. If one day the finger action feels dull and unvitalized, special practice must be directed to the action of whichever of the finger levers seems to need it, be it the metacarpal joints or the points. The reaction of this lever must be delicately opposed to the hand action, and the relative proportion arrived at which the feeling in the hand and fingers and the technical (including tonal) result approves as the right one. And so throughout the list of dynamic actions.

Exaggeration of elements is useful in a practice system. How to utilize it.

When a lever and its propelling muscles have been selected for temporary development, a valuable means of such development is exaggeration in the amount of their motion, under correct conditions. These conditions are, that *exaggeration* of *motion* should be accompanied by less

force and velocity.[1] For example, if hand and forearm impulses are to be exaggerated, causing the wrist to rise and fall more than normally, exertion of muscular power must be reduced—greater relaxation must accompany the practice.

In learning the use of levers and muscles little power should be utilized.

In preliminary practice, then, to develop the use of hand and forearm impulses and their oppositions, and to make them automatic, very little muscular power should be used—only enough to give a sense of resistance of action to reaction, so as to balance them properly. Triceps and flexors should be relaxed up to the last point which will allow of this and the hearing of the proper rhythmic accents and dynamic inflections of the melody. In such preliminary practice little tone is needed—when it is needed it can be put on easily by the mere addition of more power to the movements. In such practice it is better to restrict the flexor and triceps impulses to the accentual points, and not carry them through the whole group. If well practiced in this way the carrying of the hand action through the following tones of the group is easily attained. Such a course has the additional advantage of not overloading the fingers with too much weight to carry during practice, thus retaining their vitality of action.

The same is largely true of all preliminary practice.

Light and slow practice should predominate but in alternation with faster and heavier practice. How best to do so.

Very much practice should be done, then, with the arm relaxed to the utmost, and with a light tone production. A large share of such practice should be slow, with a consequently larger proportion of hand and forearm impulses. But this should be alternated with a smaller quantity of faster practice, and a still smaller quantity of very fast practice, according to the method advocated by Bülow (Cramer etudes), and improved on by William Mason. At the close of the practice in a given grade of velocity, the proper amount of tone should be superadded

[1] According to the law of the transformation and equivalence of forces.

by allowing the muscles to act more forcibly, and any exaggeration of motion should simultaneously be dropped. *In the faster velocities*, as before stated, *there ought never to be exaggeration of motion*, but, on the contrary, attention should be directed to making every dynamic motion as small as will transmit the neccessary force.

Development of vitality in metacarpal action.

To increase amount and vitality of action at the metacarpal joints, practice in the following manner is useful. Place the hand so that the fingers lie on consecutive keys in playing position, but relaxed. Raise a finger to an exaggerated height by action from the metacarpal joint, and strike the key with it, in such a manner that there is no cessation of motion at the top of the stroke, but the rise and fall of the finger constituting practically one movement, and that movement conceived of as the *down-stroke* of the finger. Let the whole stroke proceed from the first relaxed position of the finger to the position in which the key is depressed, with as much intensity and velocity (*but not strength*) as possible. Allow the finger to remain upon the depressed key until thorough quiet and relaxation of undue tensions is secured, before repeating the action. After practice with the fingers separately, proceed to use them serially in the same manner, and after the action has been well learned use extensions and practical musical groupings. This finger action is not to be used in playing, but to vitalize the feeling of action in the metacarpal joints. When well mastered it need only be practiced at such times as the action at those joints seems sluggish.

Development of prehensile action in the fingers.

Control of action from the other finger joints is more unusual, and may be acquired and improved by special practice. Placing the hand above the keys, let its weight rest upon the thumb. Straighten all the fingers, leaving them unbent at any joint, but relaxed. Press down a key by rather quickly flexing the finger above it at all the joints, *beginning at the first joint* next the nail. If the first joint is flexed, the others naturally follow. The key

should not be struck strenuously, but pressed down quickly and easily, and the finger-point should not slide on the key. The amount of tone is of no consequence, as the purpose is merely development of control over the finger action, by exaggerating it. After exercising a single finger, very slow trills and later the serial use of the fingers may be practiced. The fingers need not all be kept extended after a time, but each finger may be extended, beginning at the first joint, when its turn comes to play. Contact with the keys should be at the finger point, near the nail, which of course must be kept very short. The flexion of the finger during playing is of course not of this exaggerated type. But if the finger, or fingers of a group, about to play shall be held very slightly extended—in ordinary cases so as to bring the ends half an inch or less above the keys—enough flexion will be secured, provided it is properly supplemented by hand and arm action and opposition.

Position and action of the fingers when in use.

The order of practicing a passage should be somewhat similar to the natural order of producing other things—say paintings or houses. First of all the conception, the clearer the better; than the larger and more salient outlines; finally the details, from small to smaller. The conception of the technical performance of a passage should include the mental picturing of the keys to be played—first of all the salient key-groups and hand-groups, inclusive of the detailed keys which later receive consideration. After this mental action, the dynamic machinery should be brought above the key-groups and hand-groups in such a position as to be effective, and the lateral adjustments and connections practiced slowly and in velocity until facile and familiar. Only so much dynamic action, if any, should be used during this process as will make the lateral adjustments easier or more familiar. Then the dynamic action is superimposed, at first slowly and lightly, than in greater velocity (double velocity as

The natural system of practicing passages.

Mason advises is best), and afterward in this velocity with more dynamic force, and so on. Larger dynamic actions are considered earlier than smaller ones. At first the whole passage may be practiced in various ways, and later, as the attention is attracted to more difficult sections of it, it is natural to isolate these for special attention. Then parts of these sections; and so the smallest details come in for attention, just as the painter finally polishes the minutest details of his picture, which existed at first only in large and vague outlines.

First outlines then details.

Above all, the processes of playing and learning to play must be natural processes. Natural mental and physical channels, in which the race life of the human animal has run for ages, must be sought out in any human action which we propose, and the new action conformed to those channels if we expect success. Technical inventions which oppose race habits of mind or body may seem to succeed temporarily, but inevitably end in failure and often in disaster, as witness the attempts of Schumann and a myriad of lesser talents. The processes of experimentation, induction, and deduction which lead to the discovery and adaptations of the natural laws relating to technic are as truly parts of natural science, and make use of the scientific method as properly, as any other section of the wide domain of knowledge.

Technical processes must not run counter to race habits which have developed the body.

The scientific method applicable to the learning of technic.

With the most natural technical system, moreover, that which has been laboriously and methodically acquired must become a part of the subconscious working of the nerves and muscles before it can be very useful. The technic which must be thoughtfully directed at the time when the mind should be conscious only of the music to be expressed, is of inferior value, be it ever so consonant with natural law. One must, as has been well said, learn technic thoroughly and then forget it. And the technic which cannot be forgotten is apt to be unnatural. A habit, at last, responsive

Technic must become unconscious.

to need, and as little else as possible, should technic become.

The true test of technic.

Finally, it should be remembered that a technical theory is not better tested by the transcendent difficulties which its application will overcome, than by the adequacy and perfection which it makes possible in the production of smaller things. Technic is but the slave of art, and art ministers to the soul's expression of beautiful truth, rather than astounds with intellectual or physical marvels.

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